INTELLIGENT MILKING SYSTEMS

Computerized Dairy Cows Management and Control Systems

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ABSTRACT

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The purpose of this thesis is to define an Intelligent Milking System as a modern technology and innovation in the dairy farming that allows farmers to use computerized machines to do diversified activities regarding their dairy cattle management and productions systems. This thesis will explain why Kenya should adopt the use of this milking system in its dairy sector.

In addition, it will explore how this system works in a typical dairy farm and highlight important considerations that will ensure farmers get high quality services and products. Moreover, it will present the importance of using milking machines in the dairy sector and how this has changed the lives of farmers, their animals and dependants.

The paper will describe two Finnish case studies where Intelligent Milking System (IMS) has been successfully embraced. It will also highlight the significance of adopting this practice by the Kenya Dairy Board (KDB) to boost milk production quality and quantity in Kenya.

Lastly, it will present recommendations on how this method can be improved to ensure there is a maximum profit generation, reduced costs and improved quality and quantity of milk supply.

Keywords: Technology, Systems, Production, Yields, Supply, Modern, Milking Robot, Computerized Milking, IT in Milking, Voluntary Milking (VMS), Kenya Dairy Board (KBD), Poverty Reduction and Robot Milking in Kenya.

CONTENTS

1 INTRODUCTION

The human population has increased and forced people to encroach on fertile lands that are supposed to be used for agricultural activities. Food scarcity is becoming a daily trouble and thus people are forced to look for ways of ensuring the available land is used appropriately. Farming practices have transformed from traditional nomadic practices to modern sedentary lives. Zero grazing has become a common practice in both developing and developed nations and people continue to invest in research to ensure they boost milk production (Hogeveen 2001, 157).

However, the cost of dairy farms labor has pushed farmers to reduce the number of human workers in their farms to ensure they manage the effects of the high costs of feeds, equipment and drugs used in the dairy sector (Wiktorsson, Pettersson, Olofsson, Svennersten-Sjaunja & Melin 2002, 28.9.2014). The dairy farming sector has embraced the digital economy by using computers and information systems to support its farm and yard activities that ensure there is efficiency and improved milk production (Turban, Volonino, McLean & Wetherbe 2010, 4).

These authors argue that IT has become an indispensable aspect in business in the modern economy because it activates and facilitates fundamental changes in the strategic structure, operations and management of organizations because of improved productivity, cost reduction, efficiency in decision making, facilitates collaboration between departments and ensures new application strategies are developed to improve customer relations (Turban et al. 2010, 13).

The milking process became very expensive and inefficient due to an increase milk production and the need to maintain high quality and hygiene standards. Farmers are forced to use advanced ways of milking to ensure they get the best value for their investments. Automatic Milking Systems (AMS) are now widely used in developed and developing nations; hence the dairy industry has been revolutionized by modern technology (Rossing and Hogewerf 1997, 2).This paper presents how Automatic Milking Systems (AMS) work and how they can be applied in Kenya to improve the milk quality and quantities produced and at the same time to ensure that the welfare of farmers and dairy animals are given maximum attention.

2 INTELLIGENT MILKING SYSTEMS

2.1 Definition

An Intelligent Milking System (IMS) is a combination of different machines and technologies that help dairy farmers to milk and monitor the progress of their animals using sophisticated techniques.The system has replaced human workers with machines that are efficient and effective and thus assure farmers that they will get quality products and at the same time monitor the health and progress of their dairy animals (Wiking and Nielsen 2003, 316).

This system has various components that include the feeding, milking and storage systems that work together and in coordination to ensure dairy animals are given proper and quality attention by using modern technology.Technology refers to any technique that has been invented to improve the way people do things. Milking machines are modern innovations because they replace human labor with computerized processes.

2.2 Background

The introduction and use of Automatic Milking Systems dates back to 1992 when nations decided to support dairy farmers by investing in research and the production of milking machines that ensured dairy animals were milked by machines.Europe was the first country in the world to experience revolution in the agricultural sector (Schukken, Hogeveen & Smink 1999, 64). The need to supply adequate food for the ever increasing population drove farmers to seek government's interventions in promoting the quality and quantity of their products. The mid seventies saw intensified interest in fully automated milking processes due to an increase in the costs of labor in Europe.

Other technologies like machine milking, automatic detaching and teat spraying were already in use in most parts of Europe (Van der Vorst, Bos, Ouweltjes& Poelarends 2003.Date of retrieval 28.3.2014). The efforts focused on automatic cluster detachment to ensure a fully integrated and reliable automatic milking was possible. There was the need to ensure the functions of the milking

process and cow management were undertaken in automated ways by combining manual and machine systems. A conventional milking enabled worker to milk cows twice in a day, but automatic milking ensures cows are motivated and milked in an involuntary manner without direct human intervention.

The need for consumers to evaluate safety and ethical questions related to food production pushed farmers to devise new ways of ensuring dairy animals were kept in hygienic shed, fed on proper diet and has qualified handlers (Hogeveen 2001, 161).Therefore, animal health, welfare, grazing and housing conditions became major areas of concern for farmers to ensure they met the needs of consumers. In 1988, an extensive European Union research project on automated milking processes was established to address issues raised by consumers regarding unsupervised milking and feeding systems (Schukkenet al. 1999, 65).The research involved farm-level adoption mechanisms and all processes involved in feeding, milking, managing and taking care of dairy animals and products.

Advantages of IMS

First, there was reduced need for human labor because machines performed the roles of farm workers. Farmers were relieved the stress of employing workers that was very expensive and required a lot of time to interview and supervise them. Human labor devotionled to supervision of animals and ensuring the machines were in good conditions (Rossing and Hogewerf 1997, 3).

Secondly, there was consistency in milking because the machines detect the characteristics of animals and identify them. This enabled animals to have less cases of injuries and be comfortable when milked. Human milking processes exposed dairy animals to injury, stress and discomfort because people have different ways of milking (Van der et al. 2003, date of retrieval 28.3.2014). However, these machines are consistent and perform their roles with high levels of precision. For instance, milking cups sense when teats are empty and detach themselves from it; therefore, this means that milking will stop automatically when the cups sense there is no milk in the teats.In addition, this technology has been improved and modern machines are able to vary the pulsation rate and vacuum level of milk cups based on how each quarter produces milk.

Thirdly, the technology increased milking frequencies and ensured animals do not stay with milk for a long time. The average milking per day is 2.5-3 times a day and this means that cows will have less stress on udders and become more conformable (DeLaval2014, date of retrieval 29.3.2014). Moreover, if the cows go for milking before the milking time, the robot will release them automatically and therefore no milking activity will take place.

Lastly, computer control enabled farmers to collect data about their animals without the difficulties and inefficiencies associated with manual herd management. This enabled farmers to know how animals behaved when given different feeds and thus they could monitor their milk production when given different feeds. This system enables farmers to keep and track the history of their animals and thus they could easily detect changes in their behavior and check whether their animals are sick or have injuries (Schukken et al. 1999, 65).

Disadvantages of IMS

First, the cost of installing these machines is very expensive and most farmers did not afford it while others had to seek bank loans, stop other projects or dispose some of their assets to acquire them (Hogeveen 2001, 163). The cost of acquiring a milking unit was about $ 175,000 during the mid-20th century and this is only when bans were available. Thus, the cost of constructing milking parlors and paying workers were very high and most farmers experienced financial constraints regarding the installation of these machines (Caldwell 2014, 161). This method of milking was very expensive compared to conventional practices that did not involve the use of any machines.Furthermore, the cost of transporting these machines from the manufacturers was also high and this made it an ineffective technology at its initial stages (Wiking and Nielsen 2003, 316). Other setbacks included taxation on agricultural machines that translated into heavy costs of acquiring them.

Secondly, these machines have to be powered by an efficient and reliable source of energy for example electricity or generators. There were increased electricity costs due to the high energy required to operate the robots. This system requires computers to be on throughout unless when they are being serviced (Schukkenet al. 1999, 66). This means that electricity usage is unrestricted and there is high consumption of energy in these units. Farmers were forced to spend more money on electricity bills that they used to before the introduction of these systems.

Thirdly, there was increased complexity of the AMS as a result of the introduction and continuous improvement of this automated system. This means that farmers were forced to rely on manufacturers to service, repair and maintains their machines because of the nature of the technologies used to manufacture them (DeLaval 2014, date of retrieval 29.3.2014). This complexity exposed farmers to total machine failure that required prompt attention of manufacturers. Likewise, some manufacturers were located very far and it would take them several hours before they arrived to offer their services to farmers. Therefore, the complexity of the nature of these machines exposed farmers to losses and inefficiencies. Also, they were not at ease with these systems because of the unexpected AMS performances that may occur when farmers are out of their farms (Caldwell 2014, 169).

Fourthly, most farmers practiced free range or pastoral systems where animals were allowed to graze in the fields, then brought home for milking and during the evening to sleep (Rossing and Hogewerf 1997, 5). However, this system does not work well in this practice and there was the need to adopt zero grazing system because the robotic system could work better.

Therefore, cows were reluctant to go to parlors that were located very far from their grazing area. It was not easy to monitor animals in the pasture because of their movements. Thus, most farmers were forced to reduce their herds and adopt zero grazing systems that worked well with AMS (DeLaval 2014, date of retrieval 29.3.2014). The quality of milk produced using AMS has lower quality compared to the one milked through conventional ways.

The level of bacterial contamination in the AMS herds was higher than that in the conventional milking practices and this means that there was poor sanitation in the AMS (Wiking and Nielsen 2003, 316).The possibility of increased stress levels in cows that were bullied was also reported because of the flexibilities of the AMS. Some cows will attend to be milked as soon as they feel the urge and this means that those that were bullied only milked at night.

Lastly but not least, there was a decreased contact between farmers and their animals, whereby animal husbandry requires farmers to pay close attention to their animals and ensure they observe their conditions before milking them (DeLaval 2014, date of retrieval 29.3.2014).However, AMS does not make early warnings or detections on the conditions of

animals and this means that the health of animals may deteriorate and the milk production reduced drastically before the machines detect these changes (Hopster 2002, 214).

Therefore, farmers were shocked to realize that their animals had reduced their milk production yet there was no sign to warn them about this. All in all, the automated milking system took some time before it was fully embraced by most farmers in Europe and America. Changes and modifications were made to improve the quality and hygienic standards of these machines ensure farmers get efficient services.

3 THEORETICAL PERSPECTIVES

3.1 Cows Adaptation to Robotic Milking

Cows Adaptation to Robotic Milking by Janice Siegford and Jacquelyn Jacobs The theory of Jacquelyn Jacobs and Janice Siegford was based on a study conducted in 2008. Their research was aimed at investigating if cows adapt to being milked by machines as compared to traditional human services.This research was motivated by the need to reduce stress during milking that inhibits milk let-down and causing mastitis (Millar 2000, 41). The research was informed by the fact that the introduction of new machines in the environment of an animal can cause stress and affect its life.

They discovered that cows can choose when and how often they want to be milked and this affects their lifestyle. Figure 1 shows a screen capture of acomputer application of the Linux Delaval Milking applications for an individual cow time allocation. This animal information describes the time in minutes that a cow is allowed to be milked within 24 hours.

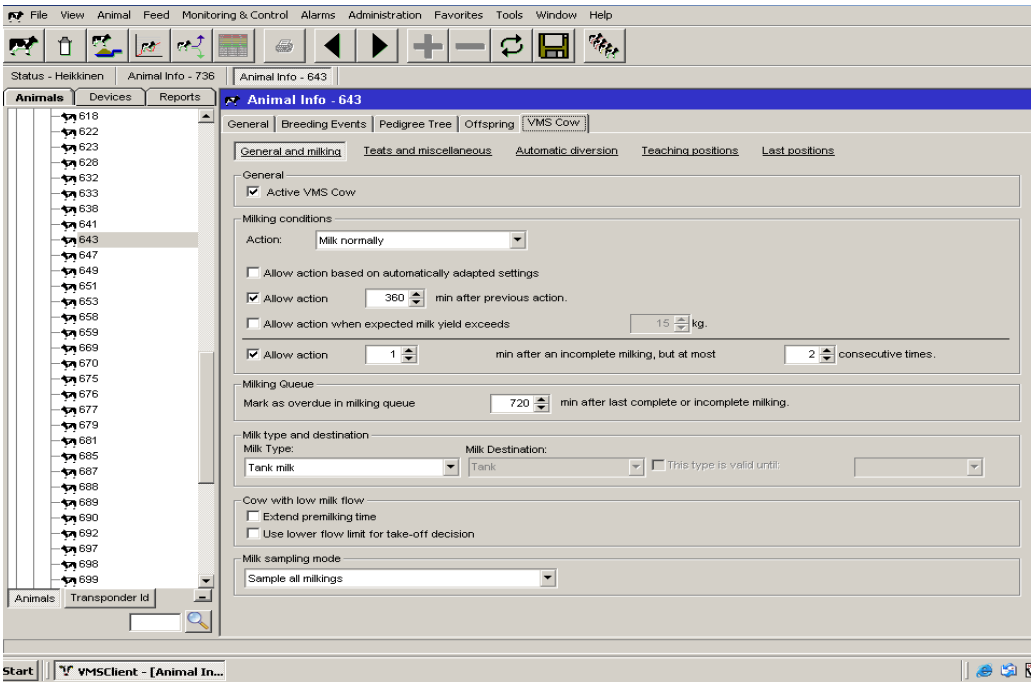

Figure 1: Milk Allocation Timetable for an individual cow

Moreover, cows do not like wasting time outside milking parlors waiting for their turns to be milked. Some cows are afraid of humans and thus the presence and actions of milking robots ensures they are not in direct contact with people.The researchers learnt the fact that automated milking processes involve the supply of concentrate feeds that stimulate milk production and keeps cows busy. They noted that the first experience of being milked my machines makes cows to be afraid and have stress and this affects how they adapt to the new systems (Rossing and Hogewerf 1997, 4). The behavior of 75 lactating Holstein cows was observed during the study as they were introduced to a Lely Astronaut A3 Milking System.

They observed that on the first day the cows exhibited uncomfortable behavior because they vocalized, eliminated any objects around them, stepped and kicked frequently because they were afraid. This showed that they did not like to be in an enclosed milking parlor or being milked by robots. All the above stress related behavior, decreased within 24 hours after the introduction and use of the robotic milking system. In addition, their focus shifted from the robotic machine and focused on the concentrate feeds available on the robot's feeder.

Similarly, the attachment of milking cups on the teats during the milking process still elicited negative reaction which increased from day 0-32 (Millar 2000, 43). The teats had to adjust to the changes and this means that the cows took long before they were comfortable to be milked by the machine. However, the good news was that the number of cows that milked themselves voluntarily increased from the first day until the end of the research. The figures 2 and 3 below show cows waiting voluntarily to be milked by the Lely and Delaval robots in a large scale firm respectively.

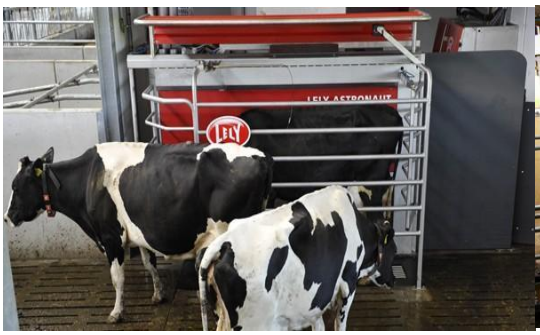

Figure 2: (Lely robot) and Figure 3: (DeLaval Robot) Cows waiting to be milked by the VMS robot. Date of retrieval 29.3.2014.
https://www.google.com/search?tbm=isch&q=Cows+on+robotic+milking#imgdii=

Alternately, farmers can adopt the use of milking stations, in which all the milking cows are milked twice a day. This system allows 30 – 60 cows to be milked at the same time and when the milking session is complete the cows are released and the next lot is let in for milking as described in Figure 4 below.

Figure 4: Milking station, It Turns and Returns. Date of retrieval 15.5.2014. http://pruned.blogspot.fi/2007/10/it-turns-and-returns.html

They believed that the reaction of cows to the AMS is determined by various factors that farmers must address to ensure there is little time wasted in transitioning from traditional to modern milking practices. The farmers have to direct their animals into the robot during the first few days of introducing the machine in their farms. Besides, they need to provide adequate concentrates on the robot's feeders to ensure animals have enough food (Van der et al.2003, date of retrieval 31.3.2014).

Therefore, there is the need to eliminate the external factors like noise and flies that affect the concentration of animals during milking. Thus, the cows will adapt quickly to robotic milking processes. They argue that there is the need for farmers to consult their colleagues and manufacturers of AMS to ensure they understand the challenges that animals possess when milked by these machines.

3.2 Milking Machine and Mastitis Control

Milking Machine and Mastitis Control by David R. Bray and Jan. K. Shearer

David R. Bray and Jan K. Shearer believe that dairy cows suffer from mastitis due to poor hygienic conditions that support the prevalence and spread of bacteria in milking equipment and sheds of animals. They argue that dairy animals should be kept in hygienic places to ensure there are no chances of spreading mastitis.

They believe that mastitis is the most costly dairy animal infection because it leads to the destruction of the milk-secreting tissue and this reduces the ability of cows to produce a lot of milk. These authors argue that subclinical mastitis cannot be detected using a strip plate; therefore, the only way to detect it is through examining the somatic cells of a dairy animal (Wiktorsson et al. 2002, date of Retrieval 28.3.2014).

This infection spreads very fast among dairy animals and within a very short time it can kill many of them (Rossing and Hogewerf 1997, 6). These authors argue that this infection can cause a reduction of about 50 pounds in milk production of an average cow.

Ways to control and eliminate mastitis as argued by Bray and Shearer;
First, they recommend that proper milking procedures are indispensable if individuals want to ensure there is proper milk production. This involves cleaning all the equipment used before, during and after milking. Also, it involves ensuring that milking units and all areas where animals spend their time should be cleaned to ensure there are no chances of harboring bacteria (DeLaval 2014, date of retrieval 28.3.2014).Disinfecting the sleeping, feeding, milking and resting places for animals against mastitis ensures that cows are free from mastitis. These hygienic regulations will ensure the health of animals is protected because they will not be in contact with bacteria and other pathogens.

Secondly, they argue that cows should be moved in a gentle and quiet manner to ensure they are not frightened. Frightening cows makes them stressed and this affects their milk letdown processes. AMS ensures animals walk into milking parlors without being forced or rushed and

this prepares them for the milking process (Schukken et al. 1999, 67).Mastitis checking is also an important of keeping cows healthy and ensuring early signs of this infection are given appropriate attention and the necessary steps taken to treat and control the spread of this disease (Hogeveen 2001, 165).

Rossing and Hogewerf argue that farmers should be checking their animals regularly to ensure they are healthy. The use of Sanitizers and pre-dipping are also effective ways of ensuring all teats are clean and free from bacterial infection. Modern AMS are made with specialized technology that ensures teats are washed and dried properly to limit the chances of bacterial infection (Wiking and Nielsen 2003, 316).

Additionally, Rossing and Hogewerf argue that the liner slips are prone to harboring bacteria and promoting mastitis. In addition, they claim that poor and malfunctioning pulsators increases the rate of mastitis infection by damaging teat ends. It is necessary to note that these authors confirm that mastitis is not caused by stray voltage in AMS.

However, this voltage increases somatic cell counts because of increased irritation. Therefore, farmers are able to monitor the activities of their dairy animals using a computer located in an office in their farms as shown in Figure 5 below.

Figure 5: A farmer operating the Computerized Data collection and analysis center for all the milking activities done. Date of retrieval 28.3.2014
http://waynehutchinson.photodeck.com/media/11ad8e86-3d08-11e0-beab-6d9144c82bc3-farmer-operating-a-robotic-milking-machine

4 CASE STUDIES

4.1 Urpo Heikkinen Farm

The farm was established with AMS in summer 2008 and this has steadily transformed milk production in this farm as compared to the previous manual milking. The installation of a single automatic milking robot has enabled this farm to exceed its annual milk production capacity of 700,000 kg since 2008. The DeLaval Voluntary Milking System (VMS) ensures there are about 200 milking sessions per day and every session produces about 11-15 kg.

This farm has 75 milking cows as per March 2014. Most cows exceeded the daily yields of 60 kg because they attend milking sessions four times a day at an interval of 6 hours/milking cow. Heikkinen admits that some of those cows produce up to 80 kg per day; he has observed that, frequent milking reduces chances of udder infections and other health complications associated with delayed milking.However, the farm notes that there is the need for close supervision to ensure all cows are milked as frequent as possible. There is the need for cow traffic to be maintained but sometimes some issues affect this traffic and this forces worker to step in and investigate issues that cause these disturbances.

The 2013 lightning strike that destroyed a nearby transformer and most of the electronics in the barn is an example of how the cow traffic can be affected in a farm (Van der et al. 2003, date of retrieval 29.3.2014). However, the milk production decreased and it took almost four months before normalcy was restored.In addition, the projected milk production of 760,000 kg of milk in 2013 dropped to 732,000 kg. The farm admits that the milking robot provides time flexibility and reduces the sweaty chores and other jobs that involved manual labor.

Most of their time is spent in supervising, monitoring and adjusting various components to ensure the system works properly and all animals are in good conditions. The farm is a living testimony of how the AMS has transformed the production of milking activities and thus it offers a credible field excursion that is important in advocating for the importance of modern technology in improving dairy farming. Technology has been embraced in this farming by the use of a

computerized management system that tracks, keeps records and analyses the data of all animals.

This is important in ensuring that the farm can study its stock and take appropriate measures to improve it. Figure 6 below shows the milk production record used by farmers to track the performance of their dairy animals. Any fluctuation in milk production is easily noted and immediate measures taken to address the problem. The farm endeavors to expand its stock and ensure it has as many dairy cows as possible.

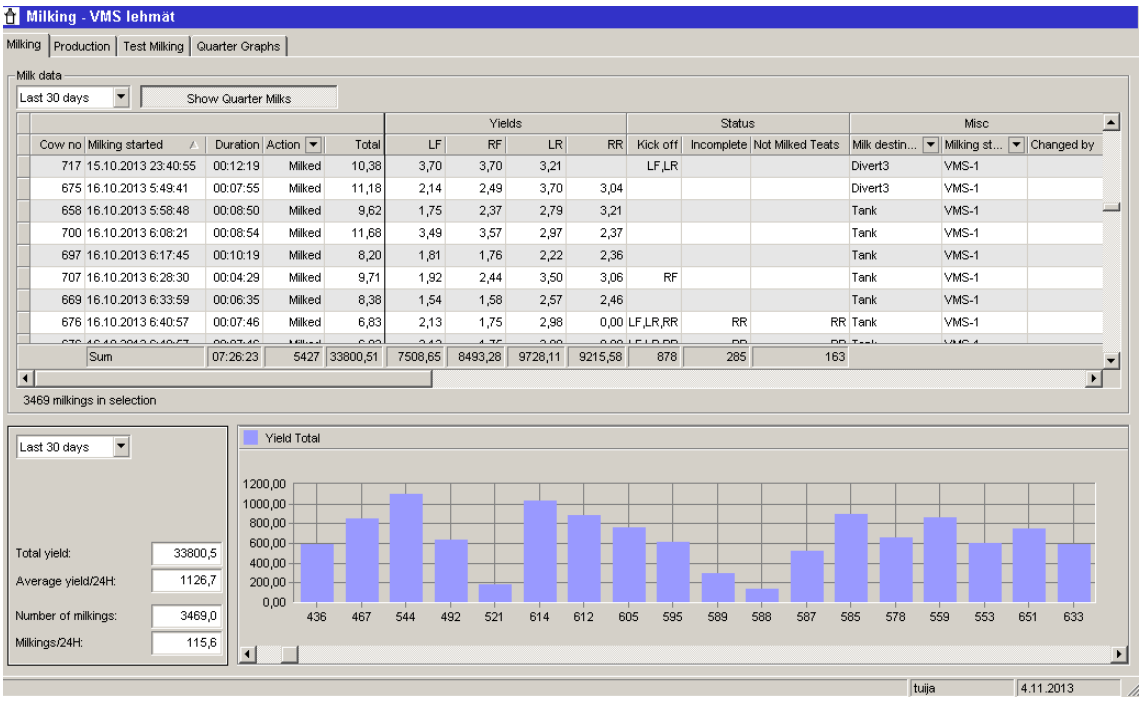

Figure 6: A screen short of Milk Production Record and graphical analysis for the months of Nov. 2013,taken from the Heikkinen's farm computer.

The advantages derived from this farming method;

Coordinated and directed cow traffic flow that ensures all animals are milked at specific intervals depending on their milk letdown rates (Rossing & Hogewerf 1997, 8).Occasionally, cases of mastitis have reduced in this farm because of improved hygienic conditions that ensure udders and animals are washed and disinfected properly.Also, it has helped the farm to acquire and breed animals with a good udder structure that is fast to milk and adjusts to the milking robots easily. In addition, feeding has been automated and this ensures animals get proper, balanced and enough feeds.

Lastly, it has recorded a high rate of efficiency because animals are supervised closely and disturbances addressed easily and very first (Wiking and Nielsen 2003, 316). All these issues translate into improved production of quality and quantity of milk from this farm.

4.2 Finnish Proagria

Proagriais a Finnish extension board which specializes in offering agriculture based services and products to citizens of Finland (Proagria International Services, date of retrieval 15.5.2014). It has embraced various modern practices that have contributed to its success. In 2008 Proagria developed and adopted the use of feed control systems. This technology combines livestock feed production, planning and tracking in a simplified way. This ensures farmers react quickly to changes leading to profitability in food production.

The service offered is connected with fodder production and finances and this enables the company to design the best feed options that will ensure cows get enough balanced diets (Rossing and Hogewerf 1997, 8).The board considers all major factors these are; prices, climate, nutritional value and topography that affect animal feeds. This ensures the farm adopts production practices that will generate revenues and at the same time ensure animals are fed on proper feeds. (Proagria Oulu, Services 2014a, date of retrieval 27.3.2014).

The need to reduce labor costs and to ensure cows get a proper care motivates organization to identify ways of improving its production processes (Wiking and Nielsen 2003, 316). Thus, robotic milking system was initiated to ensure the needs of dairy animals were met. Also, the organization focuses on education farmers and offering field extension services to them to ensure they do not have problems transitioning from traditional to mechanized milking systems. Likewise, the organization conducts research and offers free training on ways of improving dairy farming to ensure there is a continuous milk production (Wiktorsson et al. 2002, date of retrieval 28.3.2014). This organization promotes revolutionized dairy farming and agricultural practices.

TheFinnish Proagria Oulu works together with Faba, a Finnish organization that is mandated to offer all the cattle breeding advice, insemination, data and accessory services. It promotes high quality services that will enable high level of processing work and to improve the competitiveness

of cattle farms. (Faba, Services competitiveness of cattle farms, date of retrieval 2.6.2014). They offer also specialized services in cow's fertility counseling, ear tags mounting, data processing and online updates, conveying information of new and sold cows in a farm, and passing of ideas on how to improve services in the barn. When a cow is on heat, the farmer is required to call the Faba information desk and he has to give the following information in order; the cow tag number, cattle owner's name, number of insemination e.g. repeats heat, farmer number. This enables the inseminator to retrieve the cows breeding history and select the best semen for the cow on heat. Through Faba, Proagria offer products for livestock and livestock business professionals ranging from farm magazines and books, protective equipment's, ear tags and cows tagging. This helps the farmers to work under one umbrella having quality services.

4.3 The Kenya Dairy Board

The Kenya Dairy Board was established by an act of parliament in 1952. The introduction of exotic breeds in Kenya in 1902 and the use of artificial insemination to breed quality dairy cattle led to the desire to form a body that will be in charge of ensuring the needs of dairy farmers are met (Kenya Dairy Board 2013, date of retrieval 28.3.2014). The mission of this board is to ensure it adopts efficient practices that will transform the board into an effective and reliable dairy development and regulatory authority.In addition, its objective includes empowering farmers have access to quality services that will promote the production of competitive dairy products (Wiktorsson et al. 2002, date of retrieval 28.3.2014).

However, the board offers different services that ensure there are regulation, development and promotion of dairy farming activities in Kenya. Its services aim at benefiting milk farmers, licensers, consumers and all stakeholders that make this activity successful.

These services are divided into five groups as follows;

The Dairy Promotional Services ensures there is a maintained increase in the consumption of dairy products in Kenya and other neighboring countries (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

It develops marketing strategies to ensure the products of farmers get to their destinations and consumers at the right time. This will guarantee farmers that their milk will have a steady market and thus they will be motivated to work hard.

The Export markets for Kenya's dairy products are currently developing on well, still this board is focused on ensuring that there is a continuous demand for Kenya's dairy products in other countries (Wiktorsson et al. 2002, date of retrieval 28.3.2014). Local and international marketing of dairy products is done through the establishment and participation through the local and regional farmers' exhibitions.

The School Milk Programs have been established and this board ensures school going children have access to milk produced from various regions. It has promoted Investment in the Dairy Sectors by facilitating the formation and financial support of dairy farmers' associations at grassroots levels (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

Lastly, it benchmarks Kenya's Dairy Farming Achievements by ensuring that farmers use modern technology in producing milk. Dairy Development Services includes organizing and supporting stakeholder associations to ensure their needs are addressed.

The management of dairy information by the Kenya Board

This is a core function performed by this board to ensure farmers are not misled by unscrupulous traders who stock and distribute dairy implements (Kenya Dairy Board 2013, date of retrieval 28.3.2014). Theboard supports business development service providers to ensure that they offer quality and affordable feeds, drugs and equipment used in dairy farming to farmers.

Moreover, it focuses on capacity building to ensure there are improved productivity, quality and efficiency in this sector. The board ensures the use of appropriate technology, skills and techniques are embraced in promoting dairy farming in Kenya (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

Transfer of technology is also an important role played by this board to ensure farmers use modern, efficient and affordable technology to produce milk. Dairy Regulatory Services includes

licensing of milk handling premises. This is an important way of ensuring trade in dairy products is regulated. Farmers should get value for their milk by ensuring that traders purchase them at reasonable prices (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

This board inspects the premises of milk handlers to ensure there is no contamination or wastage of milk to promote human health. It also conducts surveillance of the quality and safety of milk and its products to detect any abnormality and take appropriate steps to arrest it. Also, it reviews and develops dairy standards to ensure farmers do not get constrained by outdated policies that limit their abilities to expand and improve their dairy farming (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

Lastly, it manages dairy imports and exports and ensures dumping of outdated technology is prohibited. In addition, it supervises the exportation of dairy products to ensure farmers get a reasonable income for their sweat. The board has played significant roles in promoting the use of robotic milking system in major farms in Kenya. For instance, it helped the Delamere Farm to imports AMS and install it in its premises.

This has boosted milk production and ensures that there is efficiency in this sector. Other big scale milk factory includes Brookside, Tuzo, Kenya Creameries Corporations (K.C.C) and Ilara have benefitted from AMS through the Kenya Diary Board (Kenya Dairy Board 2013, date of retrieval 28.3.2014).

Learning institutions like the Jomo Kenyatta University of Science and Technology, Masinde Muliro University, Kenya Institute of Farmers and Kenya Agricultural Research Institute are focusing on diversified trainings about robotic milking plants.

The board is working to ensure average size farmers have access to this machine and this will improve the quality and quantity of milk produced in Kenya. Currently, Kenyan farmers produce over 500 million liters of milk annually. The board has established information centers that play significant roles in promoting dairy farming in Kenya (Kenya Dairy Board 2013, date of retrieval 28.3.2014). The board predicts that Kenya will produce about 1.5 billion liters of milk annually from major farms and average sized farms by the use AMS in their dairy sector.

Two major challenges affecting KDB functions

This boardroom wrangles continue to dominate the board and this derails the implementation of its principle functions, policies and objectives.

The political interference makes this board to waste a lot of time in unnecessary debates instead of concentrating on its roles to farmers (Kenya Dairy Board 2013, date of retrieval 28. 3.2014).

The major challenges in the Kenyan dairy are described in depth by the following photos

Figure 7 shows the milking processes that majority of Kenyan dairy farmers use.The first picture shows a semi-modern milking robot where farmers use milking machines to milk cows, but they collect the milk themselves and store it in cold water as coolers.The second picture shows a farmer milking his cow manually, that is using traditional methods. The hind legs and neck are tied to make sure the cow does not move during milking.

The above methods take too long and are best practiced in small scale farms. Large scale farmers that use this method employs many workers to milk their cows besides to ensure that milk is delivered in cooperative societies on time.

Figure 7: (Top left) the current machine milking by medium and large size farmers. Top right; farmer milking the dairy cows manually. Date of retrieval 27.3.2014 https://www.google.fi/search?q=milking+cows+in+Kenya&espv=2&source=lnms&tbm=isch&sa=X &ei=fcWJU4i-G6bP4QTXhoGwAQ&ved=0CAYQ AUoAQ&biw=1280&bih=656

Figure 8 shows how raw milk is stored in cans from the farm level and how are transported to the milk factories; this is mostly practiced by the small scale farmers. Lack of proper storage

equipment to transport milk to processing factories makes most of it to spoil before reaching its destination.

Figure 8: How milk transportation is delivered to the factory. These are issues challenging KDB. Date of retrieval 27.3.2014.
http://www.capitalfm.co.ke/business/2013/09/vat-law-to-coagulate-dairy-sector/

5 VOLUNTARY MILKING

5.1 Automatic Feeding System

AMS has an automatic feeding system that ensures animals have feeds throughout the day and night. This has saved up to three hours of labor, reduced feeding and capital costs and improved the performance and productivity of animals. The following simple routines are important in ensuring dairy cows have adequate feeds to produce a lot of milk (Hogeveen 2001, 165).

Dairy animals should be of good health. This is a basic requirement for new and old cows. Farmers should ensure that they have healthy animals and cases of diseases should be addressed as soon as possible. (Proagria Oulu, Services 2014b, date of retrieval 29.3.2014).

An automatic feeding machine will not work properly if cows are sick and cannot move to the feeders. Farmers should ensure cows have fresh water, a clean place to sleep and an environment that's free from draft (DeLaval 2014, date of retrieval 28.3.2014). This promotes good health by ensuring disease outbreaks are controlled.

The performance of all cows should be monitored by observing computer readings for their eating behavior. Also, farmers have to observe their animals to ensure they detect any changes in animal behavior that cannot be detected by computers (Schukken et al. 1999, 216).

Cows that do not feed properly should be isolated from others so that they can be monitored properly. It is advisable to use ordinary feeding trays to feed sick or suspicious cows so that farmers can study them properly for signs of diseases.

Signs of dehydration like sunken eyes, lack of moisture (around the nose and eyes) and skin tinting are some of the common signs that cows are suffering from dehydration. The concentrate hopper should be checked regularly and replenished when they are almost empty. This will ensure animals have food throughout the day and night.

Calibration of feed and medicine delivery should also be done regularly to ensure farmers track the health requirements of their animals (DeLaval 2014, date of retrieval 28.3.2014). The mixer cleaning should be checked and cleaned on a regular basis (daily) to ensure high hygienic standards are observed.

The mixer cleaning cycle should be monitored daily and run to ensure it works properly. All remnants that have been stuck on it should, be removed manually to ensure there are no particles attached to it (Caldwell 2014, 201).The feeder outlet of the hopper should be checked regularly and any cracking removed to avoid blockage of this part.

Lastly, the water sensor should be mineral free to avoid mineral buildup in the mixer that lowers the efficiency of these machines (Hopster 2002, 215).Dairy farmers work with diversified experts from relevant authorities to ensure that they have adequate knowledge, skills and abilities to operate these feeding machines without the need of seeking assistance from the technicians or experts.

5.2 Timing

Voluntary milking refers to the unguided movement of dairy animals from their feeding or resting places to the milking robot for milking. This process is automated by the AMS and ensures animals attend the milking parlor at least twice per day (Proagria Oulu2014c, date of retrieval 29.3.2014). The whole process of automatic milking is composed of coordinated activities from feeding to milking.

The voluntary milking process is initiated by two things.

First, when cows are hungry, they will move to the milking parlors and thus they will enter their milking cages and the process of milking will start (DeLaval 2014, date of retrieval 28.3.2014).

Secondly, when cows feel they have adequate milk in their udders they will move to the milking parlors voluntarily and the milking process will start. Voluntary milking involves the movement of animals to milking parlors without the interference of a person. Therefore, cows know when to be milked and how long they will be milked (DeLaval 2014, date of retrieval 28.3.2014).

The timing of voluntary milking depends on three things.

First, cows produce milk at different intervals. Some produce little milk, but regularly and this means that they must be milked many times in a day. Others produce a lot of milk, but after long intervals and these ones may be milked twice or thrice a day.

Besides, the types of feeds given to animals also determine the timing of their voluntary milking (Wiking and Nielsen 2003, 316).Dairy cows that are properly fed on the high nutritional feeds will attend to milking many times compared to those that are not fed properly.

Lastly, dairy cows should be of good health so that the milk letdown process is not affected. Sick cows produce little or no milk, proper routine check minimizes low milk production and facilitates to healthy animals.

5.3 Milking System

The milk system is a complex stage that is controlled by various factors including hormones and physical conditions of animals. There must be cooperation from the cow so that the farmer can harvest all the milk from the cow. Cows must be treated properly from the time they are moved to the milking area (Proagria Dairy Farm 2014, date of retrieval 29.3.2014).

Proper stimulation of a cow before milking will ensure the milk letdown process is effective and thus there will be a lot of milk harvested. The stimulation process involves washing udders and fore stripping milk out of each teat.

The milking cups are fitted with special components that ensure cows are stimulated during washing and milking (Caldwell 2014, 211). Figure 9 shows the milking teats attached to the cow.

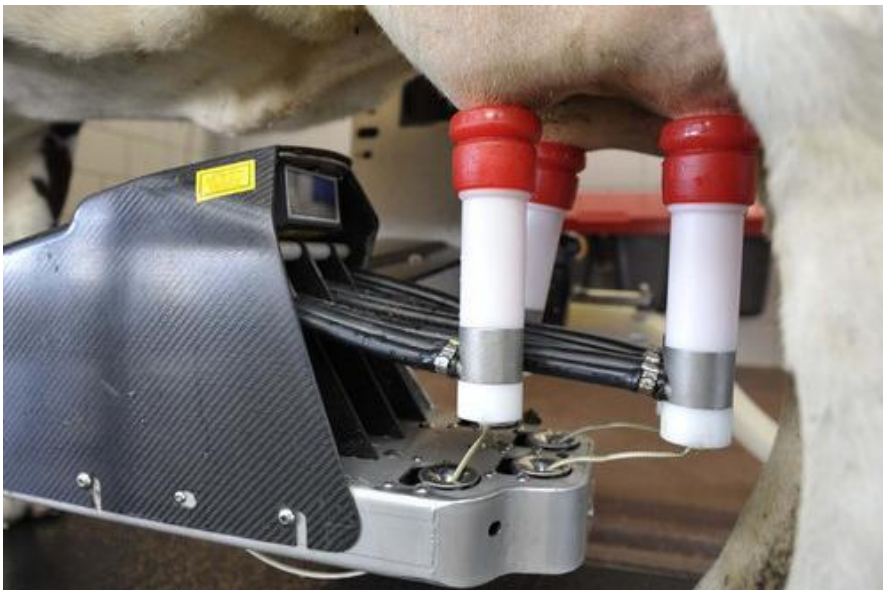

Figure 9: A Lely robot attaching milking cups ready to start an automatic milking session. Date of retrieval 30.3.2014. http://eandt.theiet.org/magazine/2010/03/images/640_milking-machine-2.jpg

The pituitary glands release oxytocin, a milk stimulating hormone- into the blood stream. This hormone circulates through the body of the animal and reaches the udder causing the stimulation and contraction of the myoepiythelial cells that make the walls of the milk filled alveoli.This forces milk out of the alveoli and into the duct system, then it is pushed into the gland and teat cisterns ready to be expelled from the body (Schukken et al. 1999, 216). The cow's cooperation may stop if it suffers an injury before or during milking and thus farmers must ensure there are no issues that may affect it during its stay in the milking parlors.

That is why farmers are usually advised to ensure the safety of cows is given maximum attention to ensure there are no objects that may injure them. Animals that have injuries usually have epinephrine, which is a hormone released to counter the effects of pain in the body and this reduces the stimulation of the udder and lowers milk production (Proagria Oulu 2014c, date of retrieval 29.3.2014).

5.4 Quantity Control

The quantity of milk produced by dairy cows is determined by various factors that should be given maximum consideration. There are artificial and natural factors that can promote or inhibit the

production of milk by a cow. Natural factors include the breed of a cow. Cows that are well bred produce a lot of milk while others do not. It is necessary to explain that most cows reared in ranches are of high quality and thus they have the ability to produce a lot of milk (Rossing and Hogewerf 1997, 15).

Breeding techniques determine the quality of animal to be born and thus farmers should select their breeds carefully. Artificial factors include the type of feeds given to animals. Animals that lack proper diets will not produce a lot of milk while those that are fed with well-balanced and adequate feeds will produce a lot of milk (DeLaval 2014, date of retrieval 28.3.2014).

The figure 10 below shows a computerized breeding cycle from the Urpo Heikkinen farm. These method help the farmers to control their milking cows breeding systems, besides it shows the breeding history of the cow, this is major area that farmers have to take great care at.

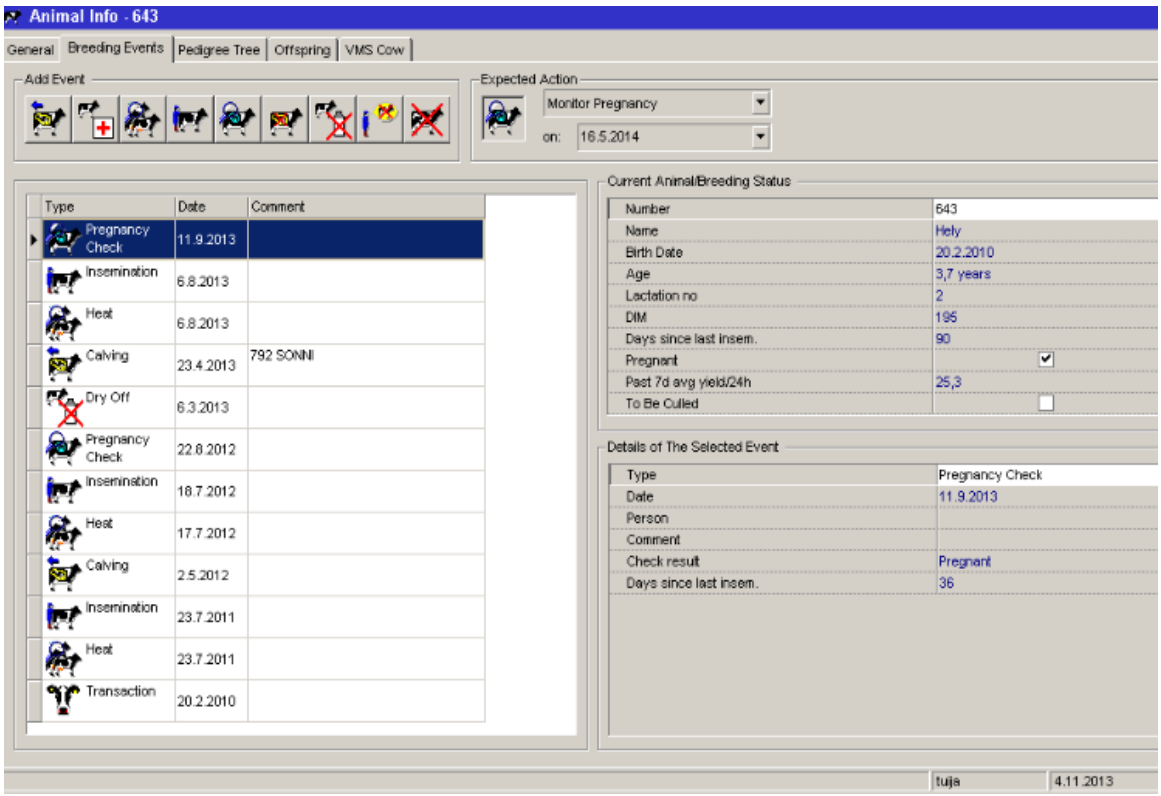

Figure 10: Breeding history of a cow, from the Heikkinen farm computer

It is necessary to explain that farmers will get milk according to how they invest in taking care of their animals. Those that have good breeds, but do not take good care of them will not achieve

the expected results. This means that having a superior breed is not a guarantee that farmers will get a lot of milk. Other issues that affect the quantity of milk produced include the environment of an animal (Proagria Dairy Farm 2014, date of retrieval 29.3.2014).

Cows are social animals and thus they need to be kept in environments that will not stress them. Fights within herds lower milk production because they make animals stressed. In addition, noise pollution, over exposure to wind, heat or cold may also lower the production ability of animals. Hence cow sheds should be properly constructed to ensure animals get maximum comfort.

5.5 Quality Control

The quality of milk produced by animals in AMS is determined by various factors that should be given maximum attention. Robot feeding ensures animals have adequate food on their troughs (Wiktorsson et al.2002, date of retrieval 29.3.2014). This process is regulated by animals and their feeding behavior. The machine is able to detect and produce food that is adequate for animals.

Moreover, it ensures all feeds are mixed in appropriate rations to provide animals with balanced diets. This feeding machine ensures there is timely delivery of feeds to animals whenever they need it. Therefore, the quality of milk produced will improve because of the availability of proper, balanced and adequate feeds (DeLaval 2014, date of retrieval 28.3.2014).Robot cleaning involves the use of machines to clean the components of AMS. This means that people do not play major roles in the cleaning process.

However, researchers have argued that the milk pipes and other components may sometimes not be properly cleansed and this may cause mastitis. Also, there are fears that some pipes may accumulate dust in pasts that cannot be easily cleaned and this affects the quality of milk produced.Farmers are usually requested to conduct routine checks on the hygienic conditions of their AMS to ensure all parts work properly and that there are no blockages (Hogeveen 2001, 166). Milk is a very sensitive commodity and thus farmers must ensure they store it in places that are free from any contamination.

Milk disease control and management cannot be properly done without the help of specialists. Farmers should ensure they monitor their animals using computerized and manual techniques (DeLaval 2014, date of retrieval 28.3.2014). The data collected by computers from various animals should be properly analyzed to ensure farmers understand the health of their animals.
Sick animals or those that do not feed properly should be checked to ensure their conditions are ascertained. In addition, farmers should monitor milk production and when it drops they should investigate and know the causes for this. It is necessary to explain that most farmers ignore early signs of animal diseases and when they act is usually too late to save the situations (Van der et al.2003, date of retrieval 30.3.2014).

The movement of animals can also offer clues to their health conditions and this means that the presence of AMS alone cannot help identify sick or injured animals (Proagria Oulu 2014b, date of retrieval 29.3.2014). Vaccination is a common way of preventing diseases in herds and farmers must have vaccination calendars to ensure their animals get routine checks and evaluation of their health conditions.

The curling of sick animals helps to prevents the spread of diseases in herds and that is why farmers must supervise and monitor their animals and stop depending only on the data presented by the AMS (Ouweltjes 2004, date of retrieval 31.3.2014).Likewise, proper hygienic conditions ensures all bacteria and disease causing vectors are eliminated from cow sheds and all equipment used in feeding or milking them. Farmers should disinfect cow sheds and ensure all people accessing them step on disinfectants to prevent cases of disease spread from other farms or places (Wiktorsson et al. 2002, date of retrieval 28.3.2014).

All milking, feeding and drinking equipment must be properly washed and stored to ensure they are free from contamination (Hogeveen 2001, 167). Farmers should establish hygienic routines that will ensure all places are cleaned and kept tidy to reduce the chances of bacterial infections. There are no chances that disinfected places will harbor bacteria and thus farmers should ensure their farms are disinfected especially during the beginning and end of dry seasons.

Animals introduced to farms from other should be kept in isolation for several days before they are allowed to mingle with others (DeLaval 2014, date of retrieval 28.3.2014). This is a safety

measure that ensures diseases are not spread from one farm to another. There is the need for farmers to work closely with field extension officers to get up to date information regarding best dairy farming practices.

5.6 Alarm

Animals are very sensitive to changes in temperature or other factors that may affect them. AMS are fitted with alarms that notify farmers when there are changes in the temperature of milking cups, dispensers, pulsators and other equipment.Sometimes farmers experience power problems and this may cause huge losses if the situation is not managed properly (Ouweltjes 2004, date of retrieval 31.3.2014). Cases of stray currents are common in most farms and farmers are usually advised to have alternative sources of energy.

They should respond to alarms raised by the machines and animals. An alarm may be as simple as a reduction in milk production or smoke emitted from the AMS. Therefore, farmers must be equipped with the basic technical skills of managing power related disasters as soon as they occur (Schukken et al. 1999, 216).

Some simple electric faults can destroy entire housing units if they are not properly managed. There is the need for farmers to have emergency contacts to ensure they get the help of professionals when disasters occur. Manufacturers of AMS are some important people that can offer professional advice or technical help to farmers. It is necessary to explain that farmers should take appropriate steps immediately they notice changes in behavior of animals or a drop in milk production.

This is a safety precaution that will ensure they save the lives of their animals and their property from diseases and destruction respectively. It is necessary to explain that when simple alarms are ignored the AMS is exposed to risks and thus the more the alarm keeps being ignored the huge the disaster that will befall a farm.Therefore, farmers should be prepared to manage simple complications to avert huge disasters.

Figure 11 shows a record of the alarm history for the last 72 hours at Urpo's Farm. The alarm system detects changes in the milking robot and records the data in this table which will be used by farmers to monitor and improve the performance of the system.

Report - Alarms

Mode | Description

Date/time range 9.4.2014 9:06:04 -> 12.4.2014 9:06:04

Device	Date And Time	Major Error Code	Minor Error Code	Remark
VMS-1	2014.04.09 14:35:01	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.09 20:47:58	5	109	Good milk valve in wrong position.
VMS-1	2014.04.09 22:01:42	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.10 08:30:25	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.10 14:21:23	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.10 17:30:36	1	112	Unexpected high yield. LR. no. 1.
VMS-1	2014.04.10 19:48:38	5	109	Good milk valve in wrong position.
VMS-1	2014.04.10 22:37:48	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.11 10:31:40	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.11 10:31:40	1	107	Several milkings failed.
VMS-1	2014.04.11 22:24:01	5	109	Good milk valve in wrong position.
VMS-1	2014.04.11 23:58:41	1	110	Unknown cow with transponder 5771.
VMS-1	2014.04.12 07:57:32	5	130	
VMS-1	2014.04.12 07:57:36	5	130	
VMS-1	2014.04.12 07:57:39	5	130	

Figure 11; Alarms history for the last 72 hours at Urpo's Farm

6 IMS MANAGEMENT AND CONTROL ASPECTS

The AMS may seem to be a simple technology but this is not usually the case. Farmers must be prepared to do the tedious work of supervising and ensuring this system works. Although, it eliminates manual labor, the machine and its components must be operated and supervised by people (Wiktorsson et al. 2002, date of retrieval 28.3.2014).This means that there is absolutely no time when human labor will be eliminated in the milking process. The fact that farmers must supervise these machines and their dairy cows shows that there need to pay very close attention to their barns.

Farmers need adequate knowledge and skills to operate these machines and manage simple errors. The process of installing these machines may require expertise, services but farmers perform all other management and maintenance required to ensure these machines perform their principle functions effectively.The need to regulate the feeding machine to ensure it dispenses adequate feeds is the responsibility of farm workers (Dayton 2011, 77). In addition, farmers have to avail all required feeds/nutrients to ensure that feed mill mixes them in the right proportional.

There is a need for the farmers to supervise the milking process by checking the effectiveness of milking cups, storage tanks and cooling systems. This machine sometimes fails to alert the farmer regarding break down and thus it is the responsibility of farmers to ensure that they make regular inspection of all components to ensure they perform properly (Proagria Dairy Farm 2014, date of retrieval 29.3.2014). Besides, checking the conditions of animals to ensure that all animals are healthy and produce appropriate volumes of milk.

6.1 Milk Storage and Cooling System

Traditional milking practices were very inefficient because a lot of milk got wasted due to poor storage. However, the use of AMS has reduced this problem drastically and farmers that use this system no longer experience the losses they used to have. It is necessary to explain that robotic milking enables cows to be milked on a 24 hour basis (Wiktorsson et al.2002, date of retrieval 29.3.2014).

This means that small quantities of milk are produced every hour this differs from traditional milking where a lot of milk is produced, stored and milked at the same time. Therefore, the cooling tank must have a specific load to ensure there is continuous cooling of the milk produced.Ice bank technology has been embraced by most farms to ensure the quality of milk is cooled safely, reliably and without the risk of freezing it (Proagria Dairy Farm, date of retrieval 29.3.2014). The ice bank system works by spraying water on the outer wall of the inner tank and this accelerates cooling by 50%.Figure 12 shows a milk cooling tank located on a farm level. Note the control box that ensures the temperature of the stored milk is regulated.

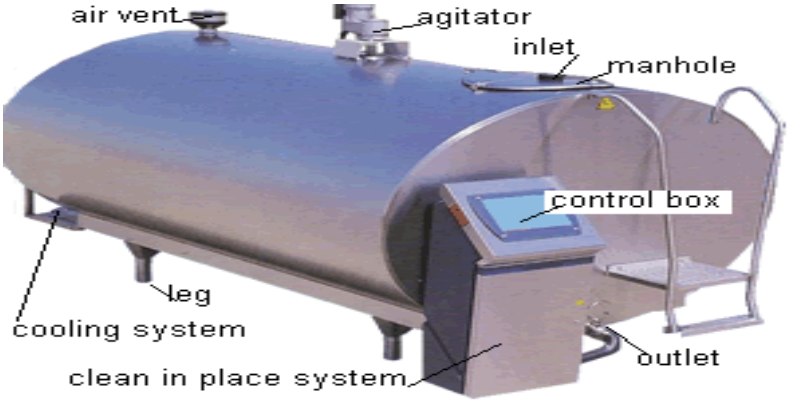

Figure 12: A refrigerated bulk milk cooling tank based at the farm level. Date of retrieval 31.3.2014. http://en.wikipedia.org/wiki/Bulk_tank

The tank has permanent ice supply to ensure there is continued cooling even when there is unstable power. Therefore, milk will not warm because the tank will regulate the heat and ensure milk is kept cool for a long time.The ice water mixer ensures there is stable temperature of about 0.5 degrees (Ouweltjes 2004, date of retrieval 31.3.2014). Tubular coolers and ice water are effective in cooling milk to about four degrees before being allowed to enter the storage tank. This ensures milk can be collected at any time the supplier (Valio Milk factory) wants even when the milking process is still going on.

Another method of cooling small quantities of milk is through direct expansion where milk is collected after a given interval and cooled. However, this is a delicate procedure and there are higher chances of interfering with the quality of milk because farmers mix milk that have different temperatures (Wiktorsson et al.2002, date of retrieval 28.3.2014).The Soft Start Cooling systems fitted in the AMS are not as reliable as the ice water in cooling milk and thus may lower milk quality.

6.2 Servicing

AMS requires regular servicing depending on their make and the manufacturers conditions. Even though, these machines have guarantees farmers must ensure they do not misuse or expose them to break down just because they will be given new ones. The need to ensure these machines work will enable farmers to have a seamless milking process and this will not affect the quality and quantity of milk produced (Wiktorsson et al. 2002, date of retrieval 28.3.2014).

Farmers are usually advised to keep checking their machines and conduct regular repairs if necessary. All machines, regardless of their improved technologies must be serviced regularly. Servicing involves greasing and oiling of movable parts to ensure a reduced friction.This reduces the tear and wear effects and makes machines to last longer (Schukken et al. 1999, 216).

It promotes smooth movement of machines and makes them to perform better. The needs to replace worn out parts ensures some parts of the machine are not overworked and also, if a worn out part is not replaced, it may damage other parts and expose the farmers to huge unnecessary expenses.

Therefore, farmers must always ensure that their machines are serviced regularly to ensure they are efficient. Animal health is very important because it affects the quality and quantity of milk produced. The sick animal's produces less milk and of very low quality (Wiktorsson et al. 2002, date of retrieval 28.3.2014).

Servicing AMS ensures all components are kept clean and this ensures diseases like mastitis are controlled easily; farmers should replace milk cups, pipes and other parts to ensure they work properly and do not expose the animals or milk to health hazards.The liners should be changed after every 25000 milking; this helps to improve the animal health by ensuring that teats are not damaged and prone to mastitis. They help also to increase the milking efficiency as the right liners ensures that clusters stay on and cows are not slow to milk. It helps to reduce stress on animals good liners don't pain on the cows teat leading to discomfort and difficulty in handling of the cow during the automatic milking process (Dayton 2011, 82). Figure 13 shows the best way of replacing milking filters to ensure the milk collected from cows is free of any dirt particle

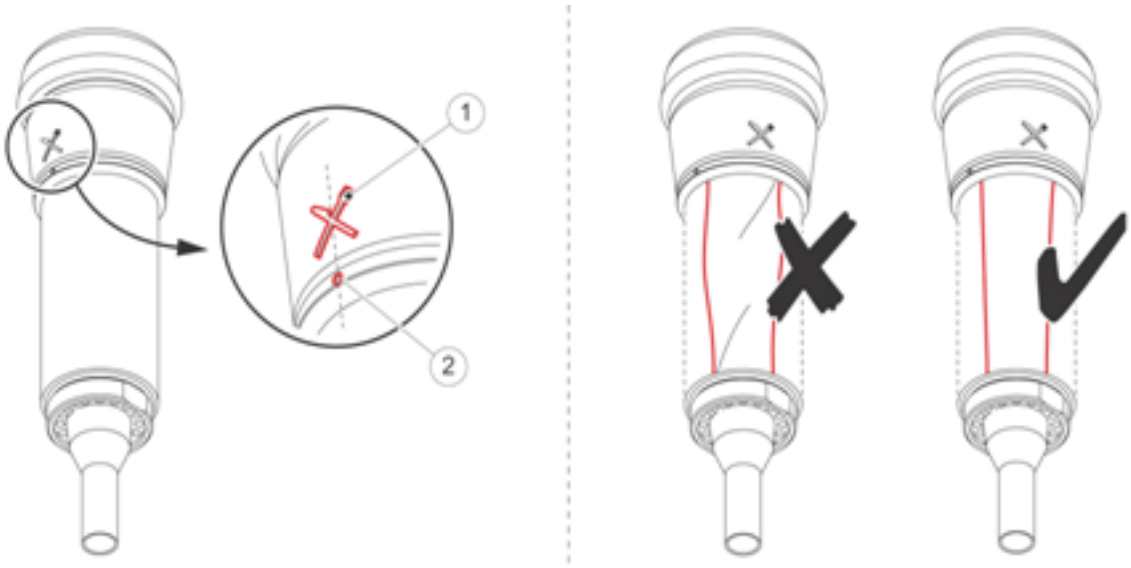

Figure 13: How to change the milking filter. On-time replacement of teat cup liners ensures optimal robot capacity. Date of retrieval 31.4.2014 http://www.lely.com/en/farming-tips/on-time-replacement-of-teat-cup-liners-ensures-optimal-robot-capacity

6.3 Energy Consumption

Energy consumption in the dairy sector is usually high when farms use AMS. This system operates for 24 hours and this means that it requires a reliable source of energy (Hopster 2002, 216). The various components of this machine are powered by electricity. This means that farmers' expenses increased electricity expenses, but this is compensated by reducing human labor.

In general, the increases in electricity consumption and expenses may not have impacts on the expenses of a farm because this system increases milk production and reduces human labor (Proagria Dairy Farm 2014, date of Retrieval 29.4.2014).The gains are more than the losses and farmers should not be worried that these machines will expose them to losses. The fluctuations that occur correspond with the seasons (summer-winter). During the cold season more heat is required to warm the farm and vice versa.As described in the Figure 14which shows the consumption of electricity at Urpo's Farm.

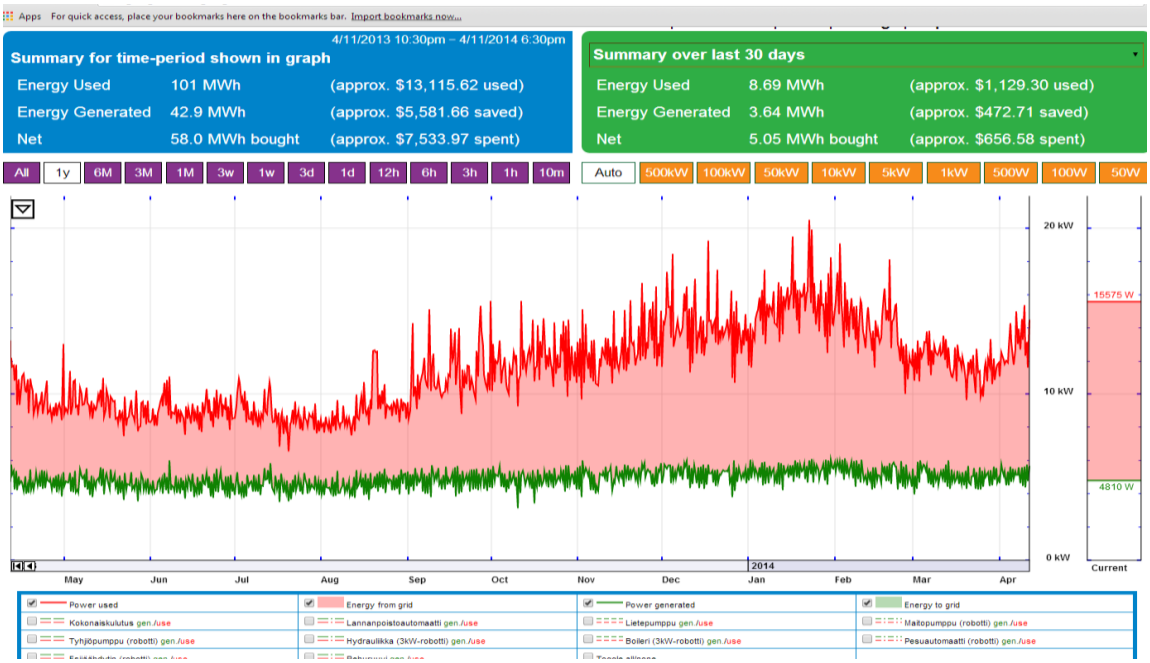

Figure 14: Showing a screen capture of an electricity energy consumption for 1 year at Urpo's Heikkinen farm (11.4.2013-11.04.2014)

6.4 Large Scale Farmers Empowerment and Motivations

Large scale farmers should form associations and seek empowerment from relevant authorities (Ouweltjes 2004, date of retrieval 31.3.2014). These measures will ensure they are informed about effective ways of promoting their activities. The large scale farmers will have access to free advice from specialists and this will help them to improve the quality of their production.

There is the need for farmers to unite and establish effective ways of ensuring their rights are respected (Dayton 2011, 89). This includes championing for the production of quality feeds and drugs for their animals. There is the need for them to realize that some unscrupulous manufacturers may take advantage of their ignorance and supply substandard feeds and drugs.Governments should invest in empowerment programs to ensure farmers are educated on bets dairy practices and technology (Ouweltjes 2004, date of retrieval 31.3.2014).Farming technologies keep improving that this means that farmers must always be up to date with the latest technology.Therefore, they should be empowered to know what is best for them and this will help to improve the quality and quantity of milk they produce.

7 ECONOMIC IMPACTS

The main economic benefits of the AMS are that it eliminates the tedious manual labor on the farm. It has various components that ensure animals feeding; milking and storage of milk are performed without the need for human energy. It is necessary to explain that this system has reduced the need to employ more workers because it reduces the need for human labor in farms (Schukken et al. 1999, 216).

Secondly, this system ensures animals are fed properly by providing adequate and balanced feeds. Hence, malnutrition and ill-health will be reduced. Farmers will feed their cows properly and thus get high quality milk.

Thirdly, the health of animals is checked and improved on a continuous basis. This means that farmers will monitor and improve the health of their cows and that this will improve the quantity and quality of milk produced. Farmers will earn more and spend less on animals' medication and this will have better economic impacts on them.

Moreover, this method promotes proper milk cooling and storage system and this enables farmers to supply milk without wastage (Schukken et al. 1999, 216). Traditional milking practices led to a lot of wastage because of poor storage and cooling system and thus farmers experienced a lot of losses.

Lastly but not least, this system ensures milk is kept safe from any form of contamination. Farmers waste a lot of milk due to poor hygiene. Milk is perishable; this system has helped farmers to milk, store and supply milk in clean containers and thus reducing wastage. Farmers earn reasonable profits from dairy farming when they use this system compared to the traditional one.

8 FINANCIAL PLAN FOR A LARGE SCALE BARN HOUSE

The following is general calculations of a monthly and yearly expenditures and income of a 100 dairy cow's barn. It's based on the current milk prices from farmers and the farms prices from neighbours in Kinangop, Kenya. It emphasizes the use of IMS as a successful business venture.

Assets			**Euros**
Second handRobotPack			20000
Construction and Installation	(60% off Robot price)	0.6 *20000	12000
Cows	500 euros/cow x 100cows	500*100	50000
Land	50 hectares @ 1000 euros	50*1000	50000
Generator	2 pieces @ 1,500 euros	2*1500	3000
	Total		**135000**
Monthly Expenses			
Labor	2 workers @ 150euros/month	2*150	300
Fuel and Maintenance	15% of Robot Cost	0,15*20000	3000
Miscellaneous	15% of Robot Cost	0,15*20000	3000
	Total		**6300**
Monthly Income			
Milk sales produced by 75% of the milking cows	50lts/cow/day, 1 litre of milk @ 0,4euros. 75% 0f 100 = 75 milking cows	1 month = 30*50	45000
Bulls, calves and culled cows	Bulls 5% of total number of cows/month	0,05*100 = 5	
	5 bulls @ 300 euros	5*300	1500
	5 Calves @ 70 euros/calf	5*70	350
	100 Hay, fodder, legumes @ 50 euros/bale	100*50	5000
	Manure, 300 euros/wagon (5 wagons/month)	300*5	1500
	Total		**53350**
8 years Payback period	Based on the Initial cost of Production/Assets		135000
	Payback/year	135000/8	16875
	Total monthly expenses		
	Payback/month	16500/12	1406,25
	Monthly expenses		6300
	Total		**7706,25**
Profit/Loss	Sales		53350
	Total		-7706,25
	Profit (+) (Euros)	**53350 - 7706,25**	**45643,75**

9 CONCLUSION AND DISCUSSIONS

The modern world has a high population and this keeps increasing despite measures to control it. Farming is suffering serious threats from encroachment of fertile lands for grazing and cultivation.However, the introduction of AMS has helped people to save time by taking care of their animals. It has reduced the costs incurred in employing human laborers and storing milk.

The AMS has improved the quality and quantity of milk produced by farmers and this has boosted their profits.Pests and diseases management and control is easier overcome, this has been lessened by the modern milking systems and therefore farmers do not have to worry much about the health of their dairy cows.Computerized health management system ensures animals are kept healthy and cases of diseases are addressed as soon as they occur. The reproduction record provides a clear picture of the individual cow and the extent of heat signs, inseminations, and dry-off to calving; hence it makes it easier to keep track of hundreds of dairy cows when dealing.

Business Information Technology combines the technological aspects of efficient, quality and reliable dairy production methods with the need to ensure dairy products fetch good prices in local and international markets.The AMS is an agro-economic innovation that ensures farmers produce quality milk that will help them to get good prices for their produces.The Intelligent Milking Systems aims at providing basic understanding and as an introduction to the use of robotic milking systems to the vast majority of the Kenyan Large Scale farmers. This is mainly to improve the deteriorating milking systems especially manual milking, which has severally exposed the consumers to milk related diseases.

This paper will act like a source of empowerment whereby farmers will have a positive return after the payback period. The AMS provides a sustainable work force as it only requires the attendant when the alarm makes a call or during the cleaning times which requires the human interface to switch on and off the scraping machines.There is the need for further research to be conducted on ways that may help Kenyan communities to embrace dairy farming. The thesis results show most Kenyans are either large scale or subsistencefarmers. Therefore, a research on the factors

that affect the popularity of dairy farming in Kenya will identify the issues that make can make IMS dairy farming unpopular.

In addition, it will expose the beliefs, traditions, lifestyle and preferences that hinder the popularity of dairy products in the Kenyan market. This will enable the Kenyan government, ministry of agriculture, KDB, private organizations and individuals to embrace and increase the popularity of IMS dairy farming in Kenya. This will make it easy for dairy farmers to embrace the use of AMS in their practices and thus boost the production of dairy products.

In my opinion, the adoption of the IMS and its use will boost the farmer's livelihood and bring new agricultural technology in Kenya. This will invite major learning institutions and students to study more about AMS and its applications. Also, it will open up short course training and research methods for farmers so as to equip them with more understanding of the IMS in their farms.This thesis has clearly opened up mind, that there is a great need of using IMS for the vast majority of the Kenyan Large Scale Farmers and the diversified dairy farmers group who if they have the knowledge and skills of using IMS, then the dairy industry will highly boost its income and overcome the different types of tropical diseases which affect the dairy sector development.

REFERENCES

Caldwell, G. 2014. The Small Scale Cheese Business: The Complete Guide to Running a Successful Farmstead Creamery. Vermont: Chelsea Green Publishing.

Dayton, C. 2011. Milking Machines. Farm Machines. New York: Power Kids Publishers.

DeLaval 2014. Finland's Largest Dairy Farm Equipments. Itself with the Country's First Automatic Milking Rotary (AMR) Enjoying State of the Art Farm Management. Date of retrieval 24.3.2014 http://www.delaval.com.

Faba. 2014. Services competitiveness of cattle farms. Date of retrieval 2.6.2014. http://www.faba.fi/palvelut.

Hogeveen, H. W. 2001, "Milking interval, milk production and milk flow-rate in an Automatic milking system", Livestock Production Science, Vol. 72, 157–167.

Hopster, H. 2002, "Stress Responses during Milking; Comparing Conventional and Automatic Milking in Primiparous Dairy Cows", Journal of Dairy Science Vol. 85, 206–216.

It Turns and Returns. Date of retrieval 15.5.2014 http://pruned.blogspot.fi/2007/10/it-turns-and-returns.html.

Kenya Dairy Board. 2013. Zero grazing with a difference. Making Dairy Farming a Profitable Venture for Kenyan Farmers. Date of Retrieval 30.3.2014 http://www.kdb.co.ke/.

Millar, K. M. 2000, "Respect for Animal Autonomy in Bioethical Analysis: The Case of Automatic Milking Systems (AMS)", Journal of Agricultural and Environmental Ethics, Springer, Netherlands, Vol. 12, No. 1, 41–50.

Ouweltjes W. 2004. Demands and opportunities for operational management support. Deliverable D28 from EU project Implications of the introduction of automatic milking on dairy farms (QLK5 2000-31006). Date of Retrieval 31.3.2014
http://www.automaticmilking.nl.

Proagria Dairy Farm, 2014. Date of retrieval 29.3.2014
https://portal.mtt.fi/portal/page/portal/proagria_international/Services/Farm%20Management.

Proagria International Services 2014. About us. Date of retrieval 15.5.2014
https://portal.mtt.fi/portal/page/portal/proagria_international/AboutUs.

Proagria Oulu, Services, 2014a. Controlling Feeding. Date of retrieval 28.3.2014
http://www.proagriaoulu.fi/fi/ruokinnan-ohjaus/.

Proagria Oulu, Services, 2014b. Animal Health Management. Date of retrieval 29.3.2014
http://www.proagriaoulu.fi/fi/elainterveyden_hallinta/.

Proagria Oulu, Services, 2014c. Milk. Date of retrieval 28.3.2014
http://www.proagriaoulu.fi/fi/proagria_maito_ja_liha/.

Rossing, W. &Hogewerf, H. 1997, “State of the art of automatic milking systems”, Computers and electronics in agriculture, Vol. 17, 1–17.

Schukken, Y. H. Hogeveen H. & Smink, B.J. 1999, "Robotic Milking and Milk Quality, Experiences From the Netherlands", National Mastitis Council Regional Meeting Proceedings 1999, 64–69.

Turban, E., Volonino, L., McLean, E. & Wetherbe, J. 2010. Information Technology for Management: Transforming organizations in the Digital Economy (International Student Version). New York: John Wiley and Sons.

Van der Vorst Y., Bos. K., Ouweltjes. W. & Poelarends J. W. 2003. Milk quality on Farms with an automatic milking system; Farm and management factors affecting milk quality. Report of the EU

Project Page 11. Implications of the introduction of automatic milking on dairy farms (QLK5-2000-31006). Date of retrieval, 28.3.2014.
http://www.automaticmilking.nl.

Wiking L. & Nielsen, T. 2003.Can strategies for cow feeding and cooling of milk in automatic milking systems improve milk quality? Italian Journal of Animal Science, 2, 316.

Wiktorsson H., Pettersson G., OlofssonJ., Svennersten-SjaunjaK.&MelinM. T. 2002. Welfare assessment of dairy cows in automatic milking systems, Welfare status of dairy cows in barns with automatic milking, Deliverables D24 from EU project Implications of the introduction of automatic milking on dairy farms (QLK5 2000-31006). Date of Retrieval 28.9.2014 http://www.automaticmilking.nl.